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Catch, bycatch and landings of blue shark (*Prionace glauca*) in the Canadian Atlantic

Prises, prises accessoires et quantités débarquées de requin bleu (*Prionace glauca*) dans l'Atlantique canadien

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Abstract

To this point, the bycatch of blue sharks in Atlantic Canada has not been examined, although it is believed to be much larger than the non-restrictive catch quotas of 250 mt applied to the directed blue shark fishery. Blue shark landings by Canadian vessels have been minimal, averaging 52 mt annually since 1990. Analysis of at-sea Observer data indicate that most of the blue shark are caught in the longline fishery for tuna, swordfish and porbeagle in deep waters off the continental shelves of Nova Scotia and Newfoundland in the latter half of the year. Virtually all is discarded at sea. Analysis by country, fishery and year indicated that blue shark bycatch accounted for 26-152% of the total large pelagic catch, and that Canadian and Japanese longliners caught most of the catch. The bycatch rate for the Canadian and Faroese porbeagle fishery was low at 7%. Canadian fisheries accounted for more than 80% of the total estimated blue shark catch, with most of that coming from the swordfishery. Total estimated annual catch ranged between 243-4048 mt since 1986, with an overall mean catch of 1346 mt. Inconsistencies in the data suggest that the bycatch rate could be 50% higher than was reported, although survival of discarded sharks would reduce bycatch mortality.

Résumé

Jusqu'ici, on n'a pas examiné les prises accessoires de requin bleu au Canada atlantique, bien qu'on les estime très supérieures au quota non restrictif de 250 tonnes métriques applicable à la pêche dirigée du requin bleu. Les débarquements de requin bleu par les navires canadiens ont été minimes, se situant en moyenne à 52 tonnes métriques par an depuis 1990. L'analyse des données recueillies par les observateurs en mer révèle que la plupart des requins bleus sont capturés dans la pêche à la palangre du thon, de l'espadon et du requin-taupe commun en eau profonde au large des plateaux continentaux de la Nouvelle-Écosse et de Terre-Neuve, dans la seconde moitié de l'année. Ils sont pratiquement tous rejetés à la mer. Selon une analyse par pays, par pêche et par année, ce sont les palangriers canadiens et japonais qui capturent la plupart des prises. Le taux de prises accessoires dans les pêches du requin-taupe commun pratiquées par les Canadiens et par les Féroïens est faible (7 %). Les pêches canadiennes représentent plus de 80 % des prises totales de requin bleu estimées, la plupart provenant de la pêche de l'espadon. Les prises annuelles totales estimées varient entre 243 et 4 048 t depuis 1986 et les prises moyennes globales se chiffrent à 1 346 tonnes métriques. Des incohérences dans les données laissent croire que le taux de prises accessoires pourrait être plus élevé, dans une proportion de 50 %, que le taux déclaré, quoique la survie des requins rejetés à la mer réduirait la mortalité accessoire.

Introduction

The blue shark (*Prionace glauca)* is a large temperate and tropical pelagic shark species of the family Carcharhinidae that occurs in the Atlantic, Pacific and Indian oceans. In Canadian waters the blue shark has been recorded off southeastern Newfoundland, the Grand Banks, the Gulf of St. Lawrence, the Scotian Shelf and in the Bay of Fundy. At certain times of the year, it is probably the most abundant large shark species in eastern Canadian waters (Templeman 1963).

The blue shark is a highly migratory viviparous species, with tagging results suggesting that there is a single well-mixed population in the North Atlantic (Casey and Kohler 1991). Females reach sexual maturity at a length of 2.2 to 3.2 m, while for males it is achieved at lengths of 1.8 to 2.8 m. After copulation the females may retain and nourish the spermatozoa in the oviducal gland for months or years while awaiting ovulation. Once the eggs have been fertilized there is a gestation period of between 9 and 12 months. The newborn pups measure 40 to 51 cm in length and litters usually consist of between 25 to 50 individuals. Further information on blue shark biology is available at the web site for the Shark Research Laboratory (www.mar.dfo-mpo.gc.ca/science/shark).

The inherent vulnerability of sharks and other elasmobranchs to overfishing and stock collapse is well documented. FAO's recently released *International Plan of Action for the Conservation and Management of Sharks* (FAO 1998) concluded that many of the world's shark species are severely depleted. The issue was also highlighted in an American Fisheries Society policy statement, which noted that most elasmobranch populations decline more rapidly and recover less quickly than do other fish populations (Musick et al. 2000). Indeed, numerous authors have noted the low productivity of elasmobranchs compared with teleosts, which is largely a result of their low fecundity and late age at sexual maturation. Although the blue shark is among the more productive of pelagic shark species (Cortés 2000), a sustainable catch level or fishing mortality has never been calculated for blue sharks in the North Atlantic. International efforts are now underway to prepare a first assessment of stock status for North Atlantic blue sharks, and Canada is participating in this process.

Prior to 1994, DFO did not have an active program of research on sharks. Increasing interest by industry to exploit sharks - particularly porbeagle, blue and mako - stimulated the Marine Fish Division at the Bedford Institute of Oceanography (BIO) to initiate a modest stock assessment effort on sharks in 1994. In 1998, an intensive research and assessment program on all aspects of Canadian shark biology and population dynamics was begun, with the initial focus being porbeagle; a full analytical assessment for porbeagle was tabled in 1999, and extended in 2001 (Campana et al. 1999, 2001). Research is now underway on blue shark, but stock assessment efforts are hampered by the low commercial value of the species, resulting in sparse landings (O'Boyle et al. 1996).

Nevertheless, anecdotal reports suggest that blue sharks are a common bycatch in some fisheries.

The objective of this analysis was to provide a first view of the blue shark catch history (including, but not limited to landings) by domestic and foreign fisheries operating in the Canadian Atlantic.

Management History

Efforts to develop a fisheries management plan for pelagic sharks in Atlantic Canada began in 1992. Pelagic sharks were not covered by fisheries regulations and amendments were required to the Fisheries Act. These amendments did not come into force until 1994. A ban on "finning" sharks (the removal of the fins and at-sea disposal of the finless carcass) was announced in June 1994 and a Management Plan for porbeagle, shortfin mako and blue sharks was announced in July 1994.

The 1995 Fisheries Management Plan for pelagic sharks in Atlantic Canada established non-restrictive catch guidelines for porbeagle (1500t), shortfin mako (250t) and blue (250t) sharks in the directed shark fishery, restricted the recreational fishery to hook and release only, and specified the collection of scientific data. The non-restrictive catch guidelines approximated the reported landings of these species in Atlantic Canada in 1992 and were not based upon estimates of stock abundance. Fishing gears to be used in the directed fishery were limited to longline, handline or rod and reel gear for commercial licenses and to rod and reel only for recreational licenses. No catch restrictions were put on shark caught as bycatch in large pelagic fisheries. Full details are presented in Campana et al. (2001).

Subsequent Canadian Atlantic Pelagic Shark Management Plans for 1997-99, 2000-2001 and 2002-2006 (Anon 1997; Anon 2000; Anon 2002) were designed to govern the exploitation of all large pelagic shark species through the maintenance of a biologically sustainable resource and a self-reliant fishery. Conservation was not to be compromised and a precautionary approach was to guide decision making. Beginning in 2000, the quota for porbeagle was based on an analytical stock assessment (Campana et al. 1999, 2001). However the precautionary TACs of 250 t for mako and blue shark remained unchanged from previous management plans.

Landings

Blue shark landings and/or nominal catch in the Canadian Atlantic (NAFO Areas 2-5) are known only for Canadian vessels landing their catch, or for foreign vessels operating under 100% observer coverage within the EEZ. Landings peaked at around 250 mt in 1994, declining thereafter to only 8 mt in 2001 (Table 1). Only Canadian, Japanese and Faroese vessels are known to have caught significant

quantities of blue shark in Canadian waters. In the northwest Atlantic as a whole (north of Florida), mean reported catches are somewhat larger, averaging 200-500 mt in the 1990s. North Atlantic nominal catches are substantially larger, reaching 25,000 mt in 1998. However, much of this catch is believed to have been caught in the northeast Atlantic.

Blue shark landings by Canadian vessels are very small, averaging 52 mt per year since 1990 (Table 2). Most of the landings are from longlines, although recreational shark fishing derbies averaging 10 mt annually have accounted for a growing proportion of the landings in recent years. 1986-2001 catch locations mapped by quarter indicate that most of the catch is restricted to the Scotian Shelf in the first half of the year, extending northwards into the Gulf of St. Lawrence and the Newfoundland shelf between July and December (Fig. 1).

Observed Bycatch

The International Observer Program (IOP) has maintained 100% coverage of foreign fisheries in the Canadian zone since 1987, thus allowing accurate determinations of both nominal catch and bycatch. IOP coverage of domestic longline vessels has been considerably less, probably on the order of 5%. Nevertheless, IOP observations indicate that Canadian, Japanese and (in earlier years) Faroese longliners caught substantially larger numbers of blue sharks than would otherwise be known from nominal catch statistics (Table 3). Blue shark bycatch in fisheries other than that for large pelagics was much smaller, although the 1-2 mt observed on 4X groundfish longlines could add up to 20-60 mt annually when pro-rated across non-observed trips.

Observed catches since 1990 have averaged about 250 mt annually, with most of that coming from Japanese vessels. In most years, virtually all of the blue shark catch was discarded. Catch locations mapped by quarter over the period 1986-2001 indicate that most of the Canadian bycatch occurred in deep waters off the continental shelves of Nova Scotia and Newfoundland, increasing in quantity through the year (Fig. 2). Significant catches have also been observed in the deep basins of the Scotian Shelf. Catch locations of Japanese longliners occurred almost exclusively off the continental shelf, and were mainly restricted to the first and last quarters of the year (Fig. 3). The location of blue shark bycatch in the Canadian and Faroese porbeagle fishery was somewhat different, being more localized on the Scotian and Newfoundland shelves, as well as in the Gulf of St. Lawrence (Fig. 4).

The relationship between blue shark catch and gear depth was given only cursory examination. The depth of the gear in all of the large pelagic fisheries was relatively shallow (< 120 m), and particularly so in the case of the Canadian fisheries. There was no consistent difference in the gear depth of sets with blue sharks, compared to those without blue sharks (Fig. 5). Anecdotal comments from porbeagle fishers, who report that blue sharks are usually caught on the hooks closest to the surface, may

reflect the tendency for blue sharks to occur in relatively warm surface waters (> 18^0C).

Estimation of Blue Shark Bycatch

To determine the magnitude of the blue shark bycatch in the various large pelagic fisheries, bycatch was estimated by country, fishery, quarter and year from Maritimes IOP observations made between 1986-2000, with bycatch defined as the summed weight of the kept and discarded blue sharks relative to the summed large pelagic catch (tuna, swordfish and porbeagle). The summed large pelagic catch accounted for virtually all of the catch, and its use in the estimation avoided problems associated with the species sought being unknown. The analysis was restricted to Canadian, Japanese and Faroese vessels, since they accounted for more than 99% of the blue shark catch. Bycatch in the foreign fisheries was fully observed, so estimation was used more to calculate bycatch proportion than bycatch weight. Total pelagic catch for each cell was determined from ZIF for Canadian vessels, and from IOP for foreign vessels.

Species sought was used as the indicator of fishery type. Where species sought was not recorded, the main species in the catch was assumed to be the target. Sets where the total large pelagic catch was less than 25 kg were not used in the analysis. This process excluded some large sets of blue shark where few other species were caught, but the overall bias is believed to be small.

For the 6 large pelagic fisheries other than porbeagle, mean blue shark bycatch accounted for 26-152% of the total large pelagic catch (Table 4). Blue shark bycatch in the porbeagle fishery was substantially less, averaging 7 %. Thus blue shark bycatch in the tuna and swordfish fisheries of both Canada and Japan was shown to be substantial, with the bycatch rate appearing to be slightly higher in the Canadian fishery than in its Japanese counterpart.

In each fishery, the blue shark proportion was assessed for trends across years. No consistent trends were evident, although proportions tended to be lower prior to 1993. The weighted mean proportion (weighted by number of observed sets) across years was used for cells missing IOP observations, but containing large pelagic catch. Cells with a blue shark proportion greater than 10 were set to 10 so as not to distort the weighted mean proportion.

Blue shark bycatch and proportions for each year and quarter in the Canadian bluefin tuna, swordfish, and other tuna (albacore, yellowfin, and bigeye) fisheries are presented in Tables 5-7. Bycatch proportions often exceeded 50%. Annual bycatch estimates for each fishery are summarized in Figs. 6-8, where they indicate that annual values averaged between 100-200 mt in each fishery except swordfish. Swordfish bycatches averaged about 1100 mt per year, with most of the bycatch occurring during the latter half of the year. Swordfish bycatch reached

3500 mt in some years, although substantial year to year variations are evident (Fig. 7).

Blue shark proportions in the porbeagle fishery tended to be small in both the Canadian and Faroese longline fisheries, averaging 7% (Table 8; Table 12). Most of the bycatch occurred in the third quarter, and annual estimates averaged about 50 mt (Fig. 9 and 13).

Blue shark bycatch proportions in the Japanese tuna and swordfish fisheries averaged about 35% (Tables 9-10). Annual bycatch in most fisheries was relatively small, averaging less than 50 mt (Figs. 10-12). However, annual bycatch in the other tuna fishery (primarily for bigeye tuna) averaged more than 100 mt, reflecting the greater weight of the target catch.

For both the domestic and foreign fisheries, most of the blue shark bycatch was caught in the 3rd or 4th quarters; very little was taken in the first quarter.

Anecdotal reports on observer catch estimation methods highlight the difficulty of estimating, or even recording, the component of the catch which is not brought onto deck before discarding. Since some Canadian vessels routinely cut off the leader of blue sharks before reaching deck, it is likely that the estimated bycatch proportions underestimate actual Canadian bycatch. In order to estimate the extent of any such underreporting, we prepared a second set of analyses based only on those sets which reported at least one blue shark. This second set of bycatch proportions assumes that blue sharks were caught in all sets, but reported only in some; thus it sets an upper limit to the bycatch estimate. We have termed this a maximum estimate, and used it to provide context for the interpretation of the bycatch in some fisheries. Minimum estimates, based on the analysis of all sets, were used for all of the baseline calculations.

To determine which type of bycatch estimate (minimum or maximum) better reflects the actual Canadian bycatch, several analyses were carried out to assess the underlying assumptions. Minimum bycatch estimates appear to be valid for the Japanese fisheries, since most sharks were brought on deck in Japanese fisheries. An analysis of the IOP observations of the Canadian and foreign fisheries indicated that there were far more sets with blue sharks reported in the Japanese tuna and swordfish fisheries than in the corresponding Canadian fisheries (Table 13). This would appear to suggest that the Canadian fisheries were carried out in areas or at times where blue shark were less prevalent. Yet when the mean blue shark catch weight per non-zero set was calculated, the Canadian blue shark catch per set was 2-4 times larger than that of the Japanese, despite the fact that Canadian sets used about one half the number of hooks used by the Japanese. These two sets of results are inconsistent with each other, and support the suggestion that at least some Canadian tuna and swordfish sets were reported as having no blue sharks because they were cut off before hitting the rail. As a point of contrast, the Canadian and Faroese porbeagle fisheries each

reported similar percentages of sets without blue sharks, and similar catch rates in the remainder (Table 13).

Supporting the hypothesis of underestimated blue shark bycatches are frequency histograms of blue shark catch frequency by country and fishery (Fig. 14). In general, one would expect a high proportion of null sets to be associated with a rapidly declining frequency of larger blue shark catches. Such a pattern was evident in all of the Japanese fisheries, as well as the porbeagle fisheries, whereby small catches of blue shark were much more frequent than large catches. However in the Canadian swordfish and other tuna fisheries, no such pattern was evident: the steepness of the frequency decline was less pronounced than in the corresponding Japanese fisheries. Once again, these results are inconsistent with each other, and more consistent with the view that observed Canadian bycatches in the swordfish and other tuna fisheries have been underreported, and hence underestimated.

A final piece of evidence was in the form of trip by trip analyses. If particular observers were more likely to record discarded sharks, they would probably do so for the entire trip, and not just individual sets. The number of trips in which no blue sharks were recorded on Canadian swordfish and other tuna vessels was 10 times higher than that on Japanese vessels. In contrast, the frequency of zero-blue shark sets within a trip where at least some blue shark sets were reported was similar in the Canadian and Japanese fisheries.

Our conclusion is that blue shark bycatch on Canadian vessels fishing swordfish, other tunas, and possibly bluefin tuna was underreported by some observers, and that actual bycatch lies somewhere in the range defined by our minimum and maximum bycatch estimates. Minimum bycatch estimates appear to be valid for the Japanese and porbeagle fisheries. Minimum and maximum estimates differ by a factor of two for some years in the Canadian swordfish and tuna fisheries (Fig. 15).

A confounding issue in the interpretation of blue shark bycatch concerns the subsequent survival or mortality of the discarded sharks. Virtually all blue shark are discarded after capture. Prior to 1994, all shark bycatch was killed by finning. In principle, sharks discarded alive and in good health after 1994 should not be included in any calculations of fishing mortality or nominal catch. Many shark species suffer a high hooking mortality because of their requirement for continued swimming to move water over their gills to breathe. However, observer observations from the 2000 and 2001 Canadian pelagic longline fishery noted that only 7-12% of the blue shark appeared to be dead at the time of discarding. An additional 3-17% were noted as being injured at the time of release. Even if most of these sharks had not been assessed at a distance, it would be impossible to determine what proportion of the discarded sharks actually survived the capture event, both in the short and long term, without some form of survival monitoring. Survival of other large pelagics caught on commercial longlines is generally

assumed to be poor (Francis et al. 2001). Assuming some additional mortality of released sharks, our estimates of recent bycatch would be somewhat higher than the bycatch that was actually killed.

Total estimated annual blue shark catches by country are shown in Table 14 and Fig. 16. Canadian large pelagic fisheries caught more than 80% of the total blue shark catch in most years. This percentage increased to 100% in 2000-2002 when the Japanese fishery in Canadian waters was closed. Total minimum annual catches have ranged between 242-4058 mt since 1986, with an overall mean catch of 1346 mt. Maximum annual catches have averaged 2315 mt.

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Table 1. Reported blue shark landings (mt) by country.

	Canadian Atlantic (NAFO Areas 2 - 5)					Northwest Atlantic				North Atlantic
Year	Canada	Faroe Is	Japan	Other	Total	Japan	USA	Other	Unspecified pelagic sharks	
1979			4		4					
1980				13	13					
1981			1		1					
1982			2		2					
1983			1		1					
1984					0					
1985					0					
1986			13		13		1			1
1987			38		38		360			526
1988			5		5		241			421
1989			10		10		232			480
1990	8		13		21	140	394			2129
1991	31	16	5		52	198	375			3029
1992	101	30	30		161	345				1767
1993	21	44	47		112	553	17			5750
1994	138		116		254	450	1		4	5880
1995	152		73		225	397	347	3		6779
1996	24		173		197	238	169	1	160	6080
1997	20		36		56	99	89	1	6	3319
1998	15		17		32	115	3	1		25161
1999	67		11		78	170	2	9	31	24243
2000	35				35					2678
2001	8				8					

Notes: Canada is from DFO Zonal Statistics File
Japan, Faroes, other countries in Canadian Atlantic are from Scotia-Fundy & NF IOP (excludes discards)
NW Atlantic landings from countries other than Japan are from ICCAT statistics for area 92
Japan in NW Atlantic represents nominal catch of unspecified sharks and rays from FAO Statistics (1999)
North Atlantic landings from ICCAT Data Preparatory Meeting for Atlantic Shark Stock Assessment, Halifax, NS Sept 2001

Table 2. Canadian landings (mt) of blue shark by fishing gear, area and year.

Year	Subarea	Longline	Handline	Gillnet	Otter trawl	Other	Derby	Subarea total	Annual total
1990	2-3							0	8
	4RST							0	
	4VW	3.16	0.17	0.5				4	
	4X5YZ	3.65	0.5	0.1		0.1		4	
1991	2-3							0	31
	4RST				0.1			0	
	4VW	11.6	0.3	0.7	7.5	1.2		21	
	4X5YZ	4.3	0.6	2.7	1.5	0.1		9	
1992	2-3	0.7			0.1			1	101
	4RST							0	
	4VW	32	1.5	0.4	3.0			37	
	4X5YZ	37.1	18.3	7.1	1.0			64	
1993	2-3	0.6						1	21
	4RST							0	
	4VW	13.5		0.4		0.1		14	
	4X5YZ	5.7	0.3	0.1	0.1			6	
1994	2-3	18.9						19	138
	4RST							0	
	4VW	18.1			0.1			18	
	4X5YZ	79.7	15.5	0.2	0.5		5.2	101	
1995	2-3	29.2			0.1			29	152
	4RST	7.6						8	
	4VW	17.4				0.2		18	
	4X5YZ	90.4		0.1	0.1		7.2	98	
1996	2-3	5.8						6	24
	4RST	6		0.3				6	
	4VW	2.6						3	
	4X5YZ	3.3		0.1			5.5	9	
1997	2-3	0.6						1	20
	4RST	4		0.1				4	
	4VW	2.8						3	
	4X5YZ	0.8	0.3	0.4			11.4	13	
1998	2-3	0.1		0.5				1	15
	4RST	1		0.2		0.1		1	
	4VW	0.2						0	
	4X5YZ	1.5	0.1		0.2		11.5	13	
1999	2-3	3		0.1				3	67
	4RST	0.1		0.1				0	
	4VW	24.8				0.2		25	
	4X5YZ	24.5					14.4	39	
2000	2-3	7.9						8	35
	4RST	0.4		0.1				1	
	4VW	2.7						3	
	4X5YZ	7.4	0.2	0.2			15.8	24	
2001	2-3			0.1				0	8
	4RST							0	
	4VW	0.1						0	
	4X5YZ	0.1					7.6	8	

Table 3. Blue shark catches (mt) by country in Canadian waters as observed by the International Observer Program. Catches include both landings and discards. The percentage of the catch that was discarded is also shown.

CATCH

Year	Canada	Faroe Is	Japan	USSR	Other	Total
1978	1		8			9
1979	10		13			23
1980		3	6	13	3	25
1981		1	13		1	15
1982			54			54
1983			26			26
1984			14			14
1985	1					1
1986			44	1		45
1987		2	159			161
1988		16	134		1	151
1989	42	8	174			224
1990	8	22	115	1		146
1991	24	65	134	19		242
1992	2	112	232		1	347
1993	15	81	233			329
1994	70		323		3	396
1995	121		173			294
1996	40		234			274
1997	28		36			64
1998	209		34			243
1999	183		292			475
2000	68		3			71
2001	166					166

DISCARD PERCENTAGE

Year	Canada	Faroes	Japan
1978	.	.	100
1979	100	.	22
1980	.	.	100
1981	.	100	73
1982	.	.	100
1983	.	.	96
1984	.	.	96
1985			
1986	.	.	80
1987	.	100	76
1988	.	100	96
1989	100	100	96
1990	100	100	92
1991	98	90	96
1992	.	73	97
1993	100	23	79
1994	78	.	64
1995	88	.	59
1996	89	.	26
1997	98	.	.
1998	100	.	45
1999	100	.	96
2000	100	.	100
2001	100	.	.

Notes: Based on data from Maritimes IOP (1978-2001) and Newfoundland IOP (1980-1995)

Table 4. Directed catch (mt) in the large pelagic fisheries of eastern Canada as observed by the Maritimes Observer Program between 1986-2000. Minimum bycatch of blue shark (mt) is also shown as a proportion of the summed directed catch.

Country	Fishery	Bluefin tuna	Swordfish	Albacore	Yellowfin	Bigeye	Porbeagle	Sum of catches	Blue Shark bycatch	Blue Shark proportion
Canada	Bluefin tuna	69	1	0	0	0	1	71	33	0.47
	Swordfish	13	472	5	29	38	8	566	380	0.67
	Other tuna	7	27	19	11	78	0	142	215	1.52
	Porbeagle	0	0	0	0	0	995	995	77	0.08
Japan	Bluefin tuna	1477	127	180	0	191	52	1986	513	0.26
	Swordfish	13	83	6	1	7	2	111	44	0.40
	Other tuna	483	378	743	912	2541	34	5490	1706	0.31
Faroes	Porbeagle	2	0	0	0	0	3363	3365	199	0.06

TABLE 5.12

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IMPORTANT NOTE CONCERNING THE FOLLOWING PAGES

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TABLE 5. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN BLUEFIN TUNA FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)		0		35	53	3				25						
	blue shark proportion		*0.48*		*0.48*	*0.48*	**0.48**				*0.48*						
	blue shark proportion (n)						2										
	blue shark catch (mt)		*0*		*17*	*26*	**1**				*12*						

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)			0						0	0	9	3	8	0	1	4
	blue shark proportion			*4.85*						*4.85*	*4.85*	*4.85*	**4.85**	*4.85*	*4.85*	*4.85*	*4.85*
	blue shark proportion (n)												4				
	blue shark catch (mt)			*0*						*1*	*1*	*44*	**15**	*39*	*2*	*4*	*18*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)		811	732	260	252	218	127	150	137	249	208	194	189	253	174	66
	blue shark proportion		*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	blue shark proportion (n)									44	14	17	7	6	22	23	9
	blue shark catch (mt)		*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		326	255	59	60	57	148	59	111	3	107	129	74	67	29	55
	blue shark proportion		*0.61*	*0.61*	*0.61*	**1.09**	*0.61*	*0.61*	*0.61*	**0.03**	*0.61*	**0.86**	**0.00**	**0.00**	*0.61*	**0.99**	**0.03**
	blue shark proportion (n)					4				6		13	2	1		13	8
	blue shark catch (mt)		*199*	*156*	*36*	**66**	*34*	*90*	*36*	**3**	*2*	**92**	**0**	**0**	*41*	**28**	**2**

FISHERY: Bluefin tuna
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 6. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN SWORDFISH FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)				2	3		48	86	71	42	40	9	31	34	39	34
	blue shark proportion				*0.55*	*0.55*		*0.55*	*0.55*	*0.55*	*0.55*	**0.66**	**0.40**	*0.55*	*0.55*	**0.07**	**0.35**
	blue shark proportion (n)											37	13			1	8
	blue shark catch (mt)				*1*	*2*		*26*	*47*	*39*	*23*	**26**	**4**	*17*	*19*	**3**	**12**

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)				526	766	682	830	1160	1623	1180	1086	583	909	930	813	699
	blue shark proportion				*0.54*	**0.19**	*0.54*	*0.54*	*0.54*	**0.27**	**0.16**	**1.26**	**0.24**	**0.20**	**1.60**	**0.44**	**1.16**
	blue shark proportion (n)					15				15	298	73	89	158	123	32	32
	blue shark catch (mt)				*284*	**146**	*368*	*448*	*626*	**438**	**189**	**1369**	**140**	**182**	**1488**	**358**	**811**

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)				87	121	189	171	298	388	324	382	83	69	81	2	2
	blue shark proportion				*4.63*	**100.00**	*4.63*	*4.63*	*4.63*	**0.22**	**0.00**	**5.46**	**0.00**	**0.00**	**3.53**	*4.63*	**1.24**
	blue shark proportion (n)					2				13	13	9	7	2	29		2
	blue shark catch (mt)				*402*	**1206***	*874*	*790*	*1379*	**85**	**0**	**2084**	**0**	**0**	**287**	*8*	**3**

FISHERY: Swordfish
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 5. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN BLUEFIN TUNA FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)		0		35	53	3				25						
	blue shark proportion		0.48		0.48	0.48	0.48				0.48						
	blue shark proportion (n)						2										
	blue shark catch (mt)		0		17	26	1				12						

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)			0						0	0	9	3	8	0	1	4
	blue shark proportion			4.85						4.85	4.85	4.85	4.85	4.85	4.85	4.85	4.85
	blue shark proportion (n)												4				
	blue shark catch (mt)			0						1	1	44	15	39	2	4	18

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)		811	732	260	252	218	127	150	137	249	208	194	189	253	174	66
	blue shark proportion		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	blue shark proportion (n)									44	14	17	7	6	22	23	9
	blue shark catch (mt)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		326	255	59	60	57	148	59	111	3	107	129	74	67	29	55
	blue shark proportion		0.61	0.61	0.61	1.09	0.61	0.61	0.61	0.03	0.61	0.86	0.00	0.00	0.61	0.99	0.03
	blue shark proportion (n)					4				6		13	2	1		13	8
	blue shark catch (mt)		199	156	36	66	34	90	36	3	2	92	0	0	41	28	2

FISHERY: Bluefin tuna
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 6. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN SWORDFISH FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)				2	3		48	86	71	42	40	9	31	34	39	34
	blue shark proportion				*0.55*	*0.55*		*0.55*	*0.55*	*0.55*	*0.55*	0.66	0.40	*0.55*	*0.55*	0.07	0.35
	blue shark proportion (n)											37	13			1	8
	blue shark catch (mt)				*1*	*2*		*26*	*47*	*39*	*23*	26	4	*17*	*19*	3	12

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)				526	766	682	830	1160	1623	1180	1086	583	909	930	813	699
	blue shark proportion				*0.54*	0.19	*0.54*	*0.54*	*0.54*	0.27	0.16	1.26	0.24	0.20	1.60	0.44	1.16
	blue shark proportion (n)					15				15	298	73	89	158	123	32	32
	blue shark catch (mt)				*284*	146	*368*	*448*	*626*	438	189	1369	140	182	1488	358	811

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)				87	121	189	171	298	388	324	382	83	69	81	2	2
	blue shark proportion				*4.63*	100.00	*4.63*	*4.63*	*4.63*	0.22	0.00	5.46	0.00	0.00	3.53	*4.63*	1.24
	blue shark proportion (n)					2				13	13	9	7	2	29		2
	blue shark catch (mt)				*402*	1206*	*874*	*790*	*1379*	85	0	2084	0	0	287	*8*	3

FISHERY: Swordfish
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 7. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN OTHER TUNA FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				7	137	6	3									
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)							1		12	24	41	51	46	42	75	76
	blue shark proportion							*1.42*		*1.42*	*1.42*	2.36	1.88	*1.42*	*1.42*	*1.42*	0.60
	blue shark proportion (n)											2	16				11
	blue shark catch (mt)							*1*		*17*	*34*	97	96	*65*	*60*	*107*	46

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)				0	0	2	26	31	88	96	269	270	184	91	98	262
	blue shark proportion				*0.35*	*0.35*	*0.35*	*0.35*	*0.35*	*0.35*	0.00	0.48	0.02	0.00	1.67	0.97	0.61
	blue shark proportion (n)										1	2	50	13	7	8	29
	blue shark catch (mt)				*0*	*0*	*1*	*9*	*11*	*31*	0	129	5	0	152	95	160

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)				166	2				2	5	3	4	30	19	50	31
	blue shark proportion				*2.48*	11.96					*2.48*	5.18		0.04	46.00	2.24	0.86
	blue shark proportion (n)					8						8		11	2	42	37
	blue shark catch (mt)				*412*	20*					*12*	16		1	190*	112	27

FISHERY: Yellowfin tuna, with addition of bigeye and albacore
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 8. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN PORBEAGLE SHARK FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)								**75**		**49**	**89**	**184**	**237**	**143**	**253**	**168**
	blue shark proportion								*0.07*		**0.11**	**0.13**	**0.02**	**0.01**	*0.07*	*0.07*	*0.07*
	blue shark proportion (n)										**53**	**48**	78	**25**			
	blue shark catch (mt)								*5*		**5**	**12**	**4**	**2**	*10*	*18*	*12*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)								**233**	**319**	**766**	**525**	**379**	**565**	**554**	**520**	**558**
	blue shark proportion								*0.02*	**0.01**	**0.02**	**0.01**	**0.00**	**0.00**	*0.02*	**0.00**	*0.02*
	blue shark proportion (n)									**14**	**139**	**93**	**1**	**3**		**1**	
	blue shark catch (mt)								*5*	**3**	**15**	**5**	**0**	**0**	*11*	**0**	*11*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)							**126**	**306**	**298**	**228**	**208**	**135**	**210**	**172**	**13**	**3**
	blue shark proportion							**0.05**	*0.24*	**0.07**	**0.65**	**0.00**	**0.03**	*0.24*	*0.24*	*0.24*	*0.24*
	blue shark proportion (n)							**57**		**71**	**72**	**1**	**34**				
	blue shark catch (mt)							**6**	*73*	**21**	**148**	**0**	**4**	*50*	*41*	*3*	*1*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)							**202**	**190**	**276**	**445**	**335**	**221**	**197**	**118**	**133**	**128**
	blue shark proportion							**0.04**	*0.04*	*0.04*	*0.04*	**0.04**	**0.01**	*0.04*	*0.04*	*0.04*	*0.04*
	blue shark proportion (n)							**33**				**55**	**2**				
	blue shark catch (mt)							**8**	*8*	*11*	*18*	**13**	**2**	*8*	*5*	*5*	*5*

FISHERY: Porbeagle shark
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: Porbeagle catch selected.sav
DATABASE FOR BLUE SHARK PROPORTION: allce78to2000.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 7. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN OTHER TUNA FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				7	137	6	3									
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)							1		12	24	41	51	46	42	75	76
	blue shark proportion							*1.42*		*1.42*	*1.42*	2.36	1.88	*1.42*	*1.42*	*1.42*	0.60
	blue shark proportion (n)											2	16				11
	blue shark catch (mt)							*1*		*17*	*34*	97	96	*65*	*60*	*107*	46

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)				0	0	2	26	31	88	96	269	270	184	91	98	262
	blue shark proportion				*0.35*	*0.35*	*0.35*	*0.35*	*0.35*	*0.35*	0.00	0.48	0.02	0.00	1.67	0.97	0.61
	blue shark proportion (n)										1	2	50	13	7	8	29
	blue shark catch (mt)				*0*	*0*	*1*	*9*	*11*	*31*	0	129	5	0	152	95	160

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)				166	2				2	5	3	4	30	19	50	31
	blue shark proportion				*2.48*	11.96					*2.48*	5.18		0.04	46.00	2.24	0.86
	blue shark proportion (n)					8						8		11	2	42	37
	blue shark catch (mt)				*412*	20*					*12*	16		1	190*	112	27

FISHERY: Yellowfin tuna, with addition of bigeye and albacore
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: ZIF catch tuna SF selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 8. BLUE SHARK BYCATCH AND PROPORTIONS IN CANADIAN PORBEAGLE SHARK FISHERY (MINIMUM ESTIMATE).

CANADA

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)								**75**		**49**	**89**	**184**	**237**	**143**	**253**	**168**
	blue shark proportion								*0.07*		**0.11**	**0.13**	**0.02**	**0.01**	*0.07*	*0.07*	*0.07*
	blue shark proportion (n)										**53**	**48**	**78**	**25**			
	blue shark catch (mt)								*5*		**5**	**12**	**4**	**2**	*10*	*18*	*12*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)								**233**	**319**	**766**	**525**	**379**	**565**	**554**	**520**	**558**
	blue shark proportion								*0.02*	**0.01**	**0.02**	**0.01**	**0.00**	**0.00**	*0.02*	**0.00**	*0.02*
	blue shark proportion (n)									**14**	**139**	**93**	**1**	**3**		**1**	
	blue shark catch (mt)								*5*	**3**	**15**	**5**	**0**	**0**	*11*	**0**	*11*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)							**126**	**306**	**298**	**228**	**208**	**135**	**210**	**172**	**13**	**3**
	blue shark proportion							**0.05**	*0.24*	**0.07**	**0.65**	**0.00**	**0.03**	*0.24*	*0.24*	*0.24*	*0.24*
	blue shark proportion (n)							**57**		**71**	**72**	**1**	**34**				
	blue shark catch (mt)							**6**	*73*	**21**	**148**	**0**	**4**	*50*	*41*	*3*	*1*

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)							**202**	**190**	**276**	**445**	**335**	**221**	**197**	**118**	**133**	**128**
	blue shark proportion							**0.04**	*0.04*	*0.04*	*0.04*	**0.04**	**0.01**	*0.04*	*0.04*	*0.04*	*0.04*
	blue shark proportion (n)							**33**				**55**	**2**				
	blue shark catch (mt)							**8**	*8*	*11*	*18*	**13**	**2**	*8*	*5*	*5*	*5*

FISHERY: Porbeagle shark
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: Porbeagle catch selected sav
DATABASE FOR BLUE SHARK PROPORTION: allce78to2000 sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 9. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE BLUEFIN TUNA FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				32	33				100	127		15	4	36	22	
	blue shark proportion				0.13	0.17				0.28	0.65		0.50	0.27	0.23	0.02	
	blue shark proportion (n)				17	27				81	76		17	5	14	6	
	blue shark catch (mt)				**4**	**6**				**28**	**83**		**7**	**1**	**8**	**0**	

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		124	98	205	200	186	207	73	58	51	86	130	7	58	147	
	blue shark proportion		0.02	0.09	0.04	0.07	0.04	0.10	0.38	0.34	0.14	0.93	1.03	0.40	0.18	0.20	
	blue shark proportion (n)		58	135	208	206	163	149	108	47	24	84	75	11	12	75	
	blue shark catch (mt)		**2**	**9**	**8**	**14**	**7**	**21**	**28**	**20**	**7**	**80**	**134**	**3**	**10**	**29**	

FISHERY: Bluefin tuna
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch.
DATABASE FOR CATCH: IOP catch tuna SF porbeagle plus bycatch selected.sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 10. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE SWORDFISH FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)					0											
	blue shark proportion					0.00											
	blue shark proportion (n)					1											
	blue shark catch (mt)					0											

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		17	33	11	41	2	2	2	1	0	1					
	blue shark proportion		0.12	0.19	0.07	0.41	2.27	1.51	0.89	5.62	13.5	1.38					
	blue shark proportion (n)		25	83	28	85	4	4	8	3	1	2					
	blue shark catch (mt)		2	6	1	17	4	4	2	4	2*	1					

FISHERY: Swordfish
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch
DATABASE FOR CATCH: IOP catch tuna SF porbeagle plus bycatch selected sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 9. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE BLUEFIN TUNA FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				32	33				100	127		15	4	36	22	
	blue shark proportion				0.13	0.17				0.28	0.65		0.50	0.27	0.23	0.02	
	blue shark proportion (n)				17	27				81	76		17	5	14	6	
	blue shark catch (mt)				**4**	**6**				**28**	**83**		**7**	**1**	**8**	**0**	

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		124	98	205	200	186	207	73	58	51	86	130	7	58	147	
	blue shark proportion		0.02	0.09	0.04	0.07	0.04	0.10	0.38	0.34	0.14	0.93	1.03	0.40	0.18	0.20	
	blue shark proportion (n)		58	135	208	206	163	149	108	47	24	84	75	11	12	75	
	blue shark catch (mt)		**2**	**9**	**8**	**14**	**7**	**21**	**28**	**20**	**7**	**80**	**134**	**3**	**10**	**29**	

FISHERY: Bluefin tuna
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch
DATABASE FOR CATCH: IOP catch tuna SF porbeagle plus bycatch selected sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 10. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE SWORDFISH FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)					0											
	blue shark proportion					0.00											
	blue shark proportion (n)					1											
	blue shark catch (mt)					0											

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		17	33	11	41	2	2	2	1	0	1					
	blue shark proportion		0.12	0.19	0.07	0.41	2.27	1.51	0.89	5.62	13.5	1.38					
	blue shark proportion (n)		25	83	28	85	4	4	8	3	1	2					
	blue shark catch (mt)		**2**	**6**	**1**	**17**	**4**	**4**	**2**	**4**	**2***	**1**					

FISHERY Swordfish
BLUE SHARK PROPORTION BASED ON tuna swordfish and porbeagle shark catch Sets with and without blue shark catch
DATABASE FOR CATCH IOP catch tuna SF porbeagle plus bycatch selected sav
DATABASE FOR BLUE SHARK PROPORTION IOP catch tuna SF porbeagle plus bycatch selected sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 11. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE OTHER TUNA FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				12	1				5	48			0	45		2
	blue shark proportion				0.29	0.17				0.23	0.39			19.5	0.22		1.34
	blue shark proportion (n)				14	2				6	29			2	23		2
	blue shark catch (mt)				3	0				1	19			4*	10		3

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)			62	14												
	blue shark proportion			0.11	0.25												
	blue shark proportion (n)			34	10												
	blue shark catch (mt)			7	3												

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		270	674	805	603	322	363	752	340	545	66	121	3	2	436	
	blue shark proportion		0.14	0.21	0.14	0.24	0.31	0.30	0.26	0.56	0.40	1.39	0.73	8.9	9.44	0.60	
	blue shark proportion (n)		261	780	599	561	244	210	578	266	318	64	55	6	3	260	
	blue shark catch (mt)		**39**	**141**	**115**	**142**	**101**	**109**	**198**	**191**	**216**	**91**	**88**	**23**	**14**	**262**	

FISHERY: Bigeye tuna, with addition of albacore and yellowfin
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch
DATABASE FOR CATCH: IOP catch tuna SF porbeagle plus bycatch selected sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 12. BLUE SHARK BYCATCH AND PROPORTIONS IN FAROESE PORBEAGLE SHARK FISHERY (MINIMUM ESTIMATE).

FAROES

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)			28	16		1	2		45							
	blue shark proportion			0.00	0.00		0.18	0.00		0.05							
	blue shark proportion (n)			13	12		2	1		27							
	blue shark catch (mt)			**0**	**0**		**0**	**0**		**2**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)			213	230	309	395	703	523	353							
	blue shark proportion			0.01	0.01	0.01	0.01	0.02	0.10	0.09							
	blue shark proportion (n)			120	111	139	184	302	331	288							
	blue shark catch (mt)			**2**	**2**	**3**	**4**	**14**	**52**	**32**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)			52	36	12	67	247	327	19							
	blue shark proportion			0.00	0.15	0.01	0.13	0.12	0.14	1.22							
	blue shark proportion (n)			28	47	14	51	181	201	40							
	blue shark catch (mt)			**0**	**5**	**0**	**9**	**30**	**46**	**23**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)			84	90	156	76	223	296	45							
	blue shark proportion			0.01	0.09	0.03	0.15	0.09	0.04	0.51							
	blue shark proportion (n)			45	79	88	68	124	138	44							
	blue shark catch (mt)			**1**	**8**	**5**	**11**	**20**	**12**	**23**							

FISHERY: Porbeagle shark
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch
DATABASE FOR CATCH: Porbeagle catch selected.sav
DATABASE FOR BLUE SHARK PROPORTION: alice78to2000.sav
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 11. BLUE SHARK BYCATCH AND PROPORTIONS IN JAPANESE OTHER TUNA FISHERY (MINIMUM ESTIMATE).

JAPAN

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)				12	1				5	48			0	45		2
	blue shark proportion				0.29	0.17				0.23	0.39			19.5	0.22		1.34
	blue shark proportion (n)				14	2				6	29			2	23		2
	blue shark catch (mt)				3	0				1	19			4*	10		3

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)																
	blue shark proportion																
	blue shark proportion (n)																
	blue shark catch (mt)																

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)			62	14												
	blue shark proportion			0.11	0.25												
	blue shark proportion (n)			34	10												
	blue shark catch (mt)			7	3												

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)		270	674	805	603	322	363	752	340	545	66	121	3	2	436	
	blue shark proportion		0.14	0.21	0.14	0.24	0.31	0.30	0.26	0.56	0.40	1.39	0.73	8.9	9.44	0.60	
	blue shark proportion (n)		261	780	599	561	244	210	578	266	318	64	55	6	3	260	
	blue shark catch (mt)		**39**	**141**	**115**	**142**	**101**	**109**	**198**	**191**	**216**	**91**	**88**	**23**	**14**	**262**	

FISHERY: Bigeye tuna, with addition of albacore and yellowfin
BLUE SHARK PROPORTION BASED ON: tuna, swordfish, and porbeagle shark catch. Sets with and without blue shark catch
DATABASE FOR CATCH: IOP catch tuna SF porbeagle plus bycatch selected sav
DATABASE FOR BLUE SHARK PROPORTION: IOP catch tuna SF porbeagle plus bycatch selected sav
* Proportion set to 10 for calculating blue shark catch
Bolded values = calculated values
Non-bolded values = weighted means

TABLE 12. BLUE SHARK BYCATCH AND PROPORTIONS IN FAROESE PORBEAGLE SHARK FISHERY (MINIMUM ESTIMATE).

FAROES

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I	tunas, SF, porbeagle catch (mt)			28	16		1	2		45							
	blue shark proportion			0.00	0.00		0.18	0.00		0.05							
	blue shark proportion (n)			13	12		2	1		27							
	blue shark catch (mt)			**0**	**0**		**0**	**0**		**2**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
II	tunas, SF, porbeagle catch (mt)			213	230	309	395	703	523	353							
	blue shark proportion			0.01	0.01	0.01	0.01	0.02	0.10	0.09							
	blue shark proportion (n)			120	111	139	184	302	331	288							
	blue shark catch (mt)			**2**	**2**	**3**	**4**	**14**	**52**	**32**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
III	tunas, SF, porbeagle catch (mt)			52	36	12	67	247	327	19							
	blue shark proportion			0.00	0.15	0.01	0.13	0.12	0.14	1.22							
	blue shark proportion (n)			28	47	14	51	181	201	40							
	blue shark catch (mt)			**0**	**5**	**0**	**9**	**30**	**46**	**23**							

QUARTILE		YEAR															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
IV	tunas, SF, porbeagle catch (mt)			84	90	156	76	223	296	45							
	blue shark proportion			0.01	0.09	0.03	0.15	0.09	0.04	0.51							
	blue shark proportion (n)			45	79	88	68	124	138	44							
	blue shark catch (mt)			**1**	**8**	**5**	**11**	**20**	**12**	**23**							

FISHERY Porbeagle shark
BLUE SHARK PROPORTION BASED ON tuna, swordfish, and porbeagle shark catch Sets with and without blue shark catch
DATABASE FOR CATCH Porbeagle catch selected sav
DATABASE FOR BLUE SHARK PROPORTION allce78to2000 sav
Bolded values = calculated values
Non-bolded values = weighted means

Table 13. Percentage of sets without blue sharks, and mean blue shark weight per non-zero set (kg), in the large pelagic fisheries of eastern Canada, as reported by the Maritimes Observer Program between 1986-2000. It is likely that some of the blue sharks caught in the Canadian tuna and swordfish fisheries were discarded at sea without first being brought on deck or recorded.

Percentage sets without blue sharks

Fishery	Canada	Japan	Faroes
Bluefin tuna	86	40	
Swordfish	51	33	
Other tuna	40	12	
Porbeagle	44		49

Kg blue sharks per non-zero set

Fishery	Canada	Japan	Faroes
Bluefin tuna	1226	531	
Swordfish	801	269	
Other tuna	1453	445	
Porbeagle	445		412

Table 14. Total estimated blue shark catch (mt) by country and year. Maximum catch estimates assume incomplete recording of blue sharks discarded without first being brought on deck.

Year	Canada		Faroes		Japan		Total	
	Min	Max	Min	Max	Min	Max	Min	Max
1986	199	517	.	.	43	56	242	573
1987	156	423	3	13	163	203	322	639
1988	1151	1901	16	20	134	172	1301	2093
1989	1464	1535	8	10	179	210	1651	1755
1990	1279	2126	24	38	112	138	1415	2302
1991	1378	2478	64	111	134	204	1576	2793
1992	2191	3849	110	215	228	243	2529	4307
1993	650	1165	80	125	244	257	974	1547
1994	460	3242	.	.	327	331	787	3573
1995	3886	6109	.	.	172	181	4058	6290
1996	270	1386	.	.	230	230	500	1616
1997	365	2141	.	.	31	31	396	2172
1998	2306	2502	.	.	43	69	2349	2571
1999	742	904	.	.	292	305	1034	1209
2000	1108	1289	.	.	3	3	1111	1292

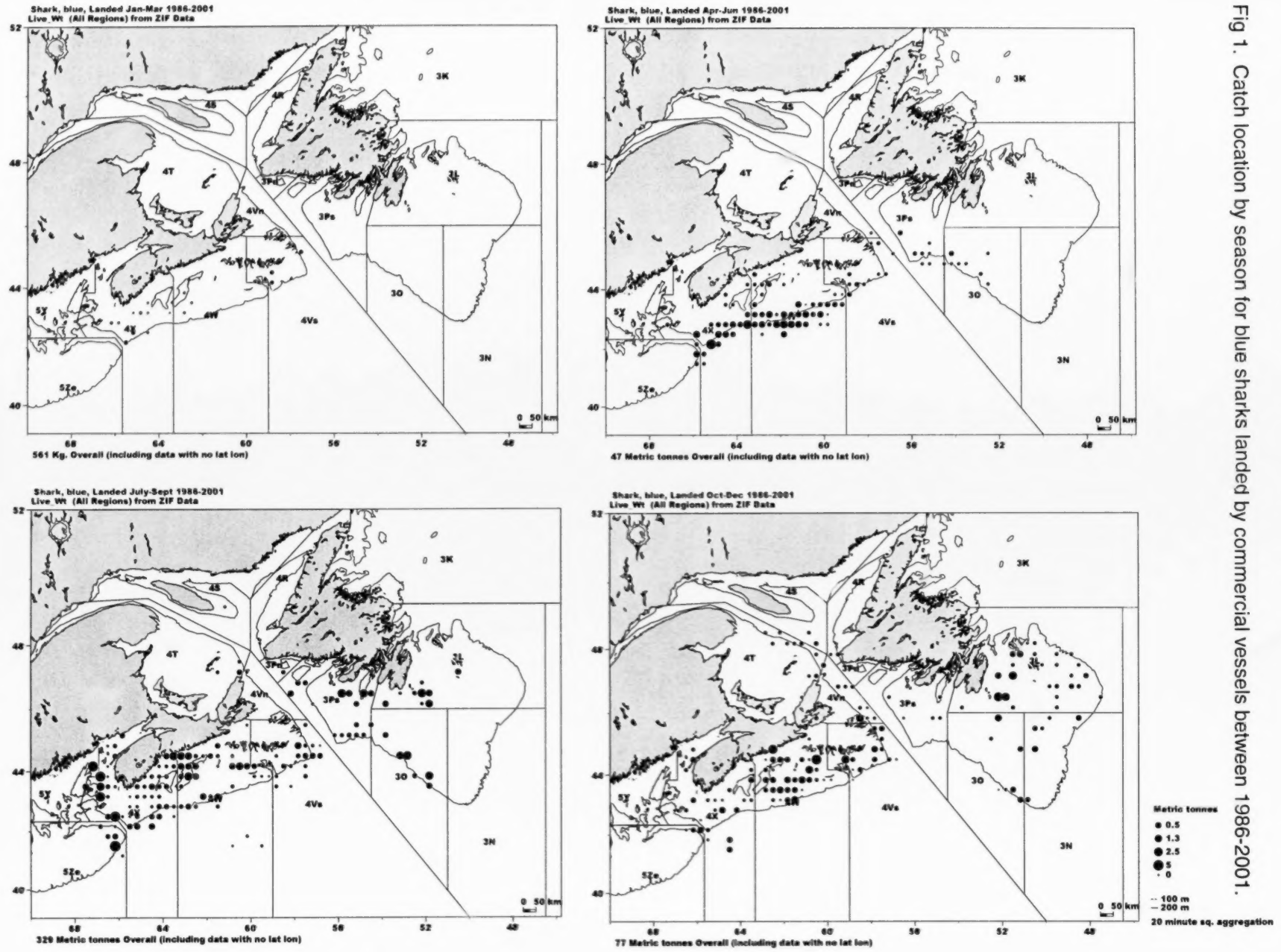


Fig 1. Catch location by season for blue sharks landed by commercial vessels between 1986-2001.

Fig. 2. Blue shark catch location by season observed by IOP on Canadian vessels fishing swordfish or tuna between 1986-2001.

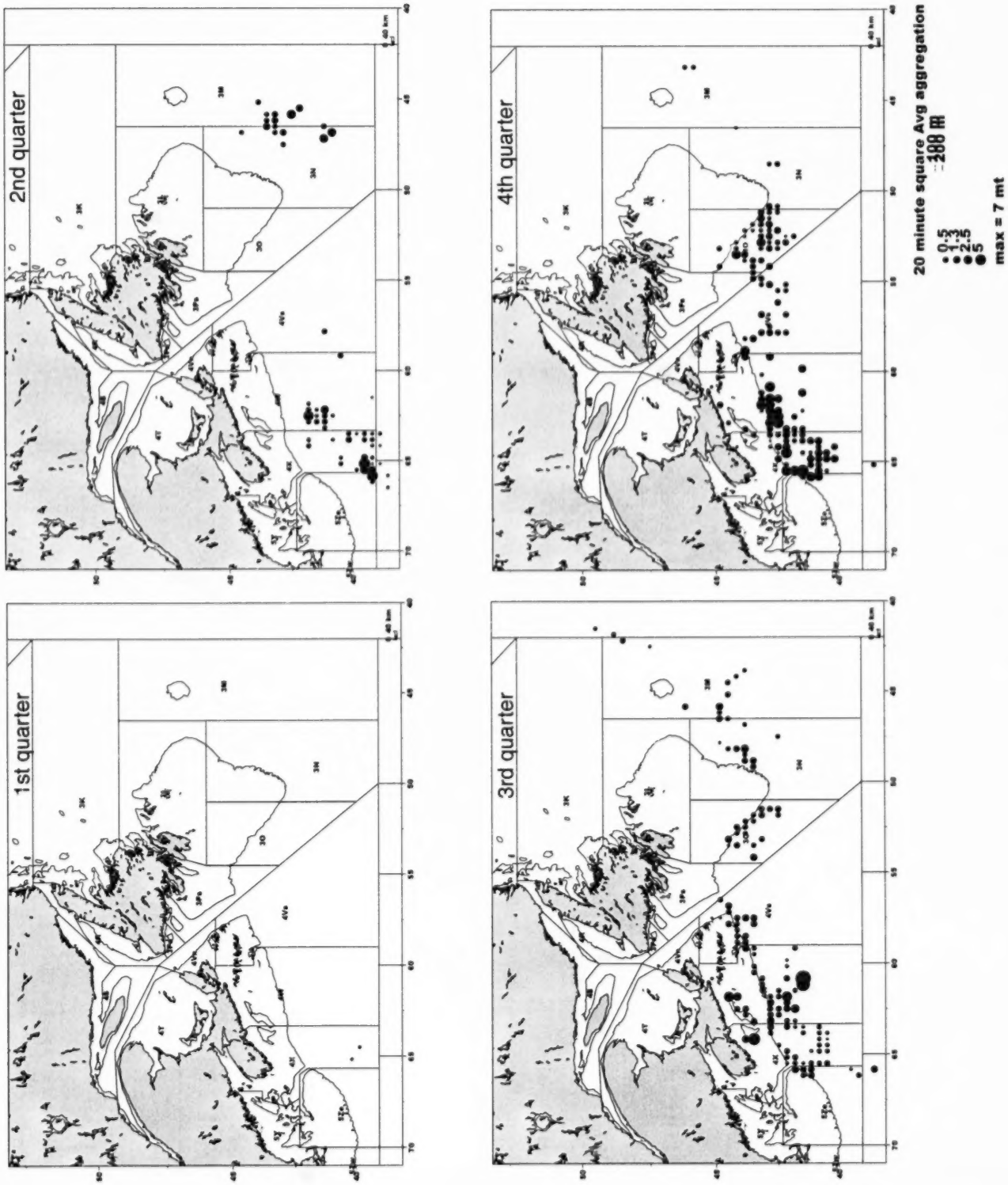


Fig. 3. Blue shark catch location by season observed by IOP on Japanese vessels fishing swordfish or tuna between 1986-2001.

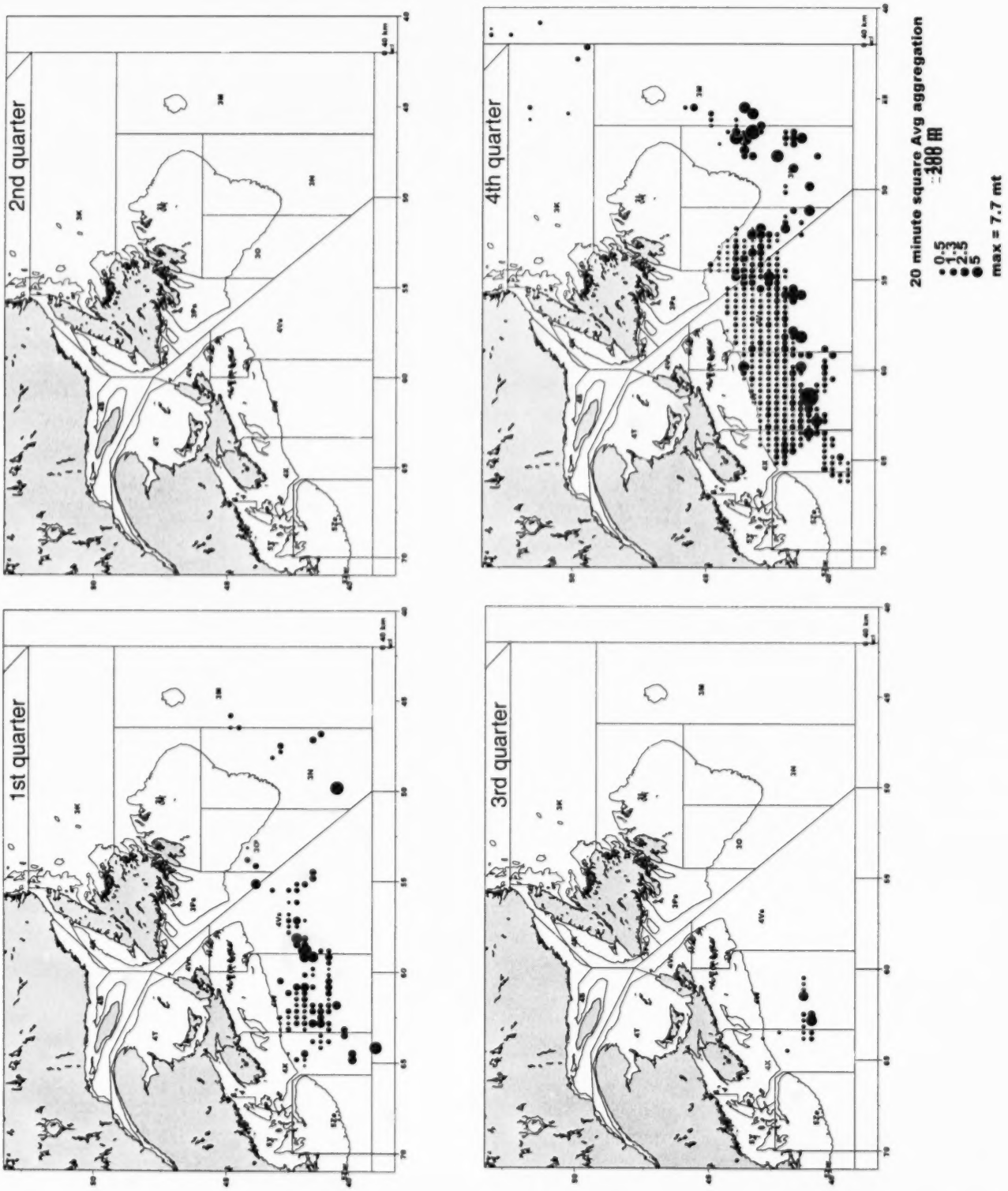


Fig. 4. Blue shark catch location by season observed by IOP on Canadian and Faroese vessels fishing porbeagle shark between 1986-2001.

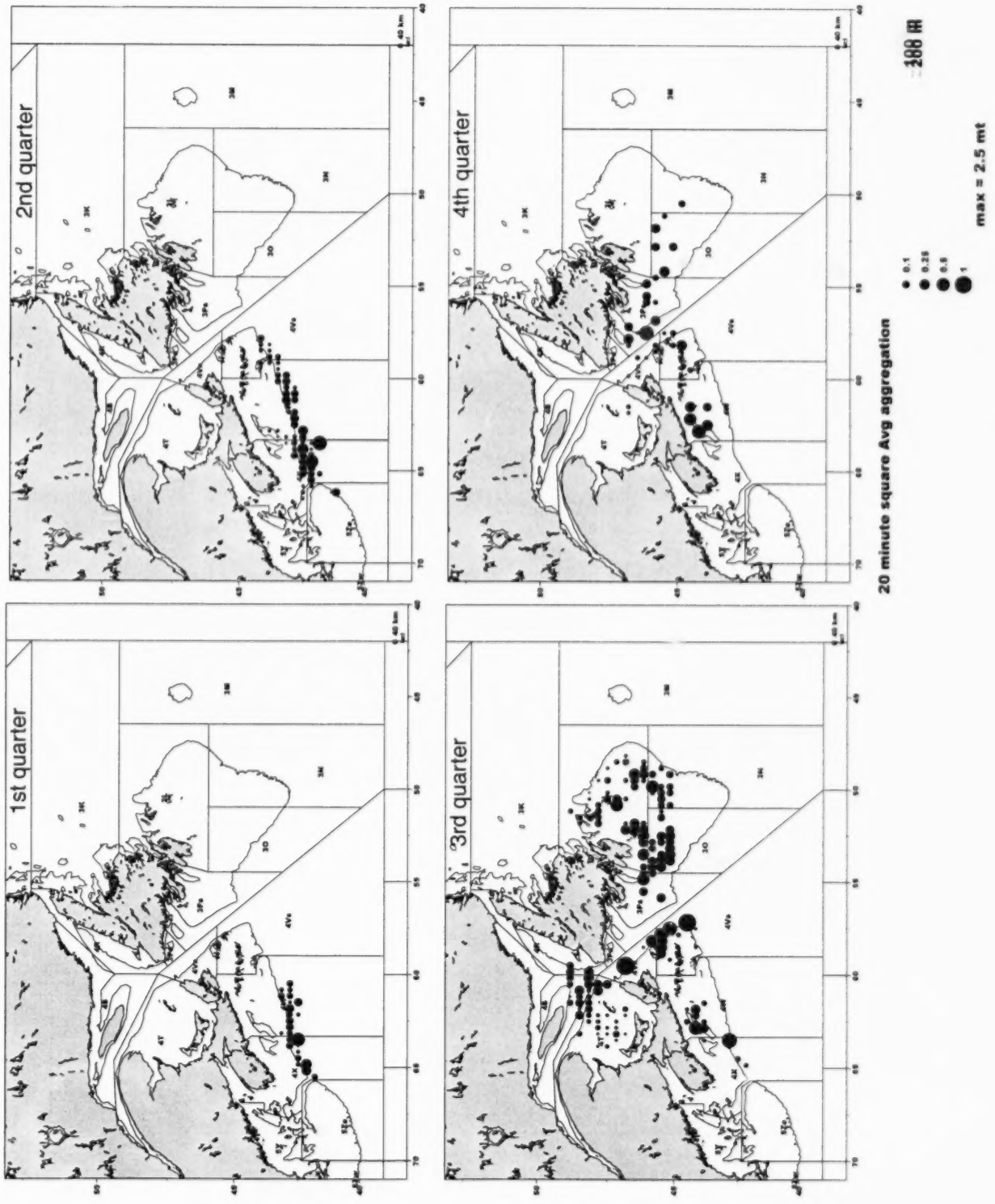


Fig. 5. Depth of gear by country in large pelagic fisheries sets.

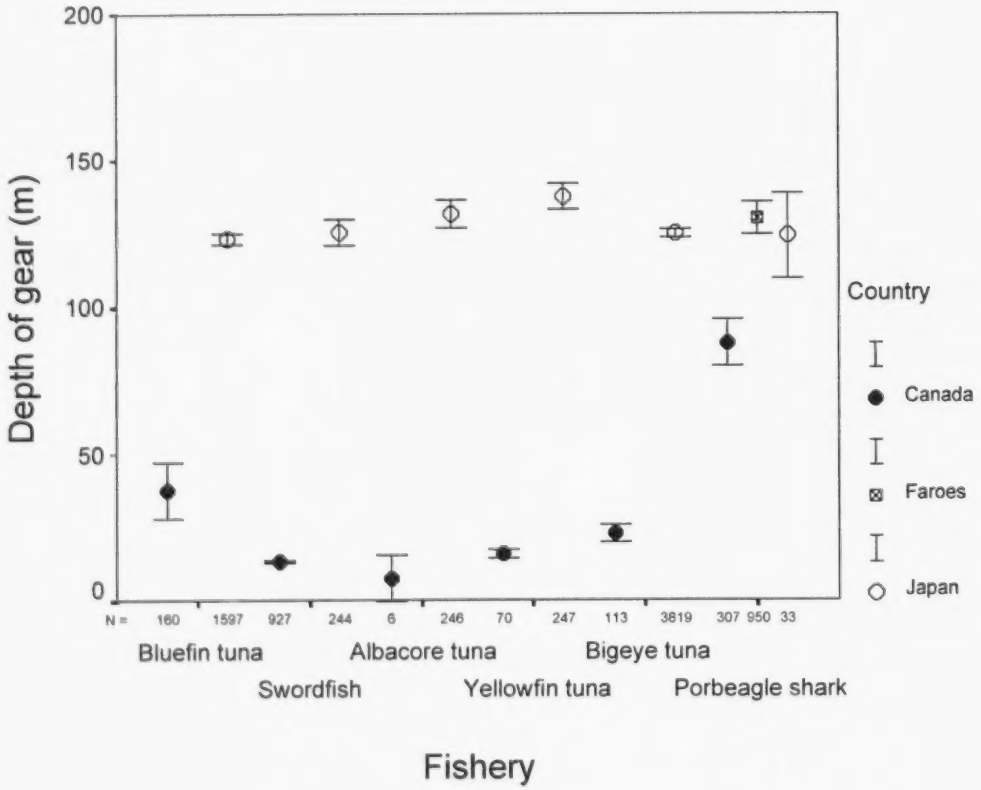


FIG. 6. ESTIMATED BYCATCH IN CANADIAN BLUEFIN TUNA FISHERY.

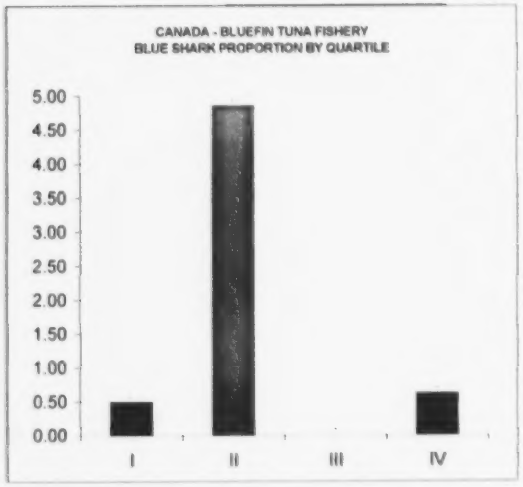
CANADA

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.48	1
II	4.85	4
III	0.00	142
IV	0.61	47
TOTAL	0.25	194

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986	0		0	199	199
1987		0	0	156	156
1988	17		0	36	52
1989	26		0	66	91
1990	1		0	34	36
1991			0	90	90
1992			0	36	36
1993		1	0	3	4
1994	12	1	0	2	15
1995		44	0	92	135
1996		15	0	0	15
1997		39	0	0	39
1998		2	0	41	43
1999		4	0	28	33
2000		18	0	2	20
TOTAL					
MEAN	11	14	0	52	64



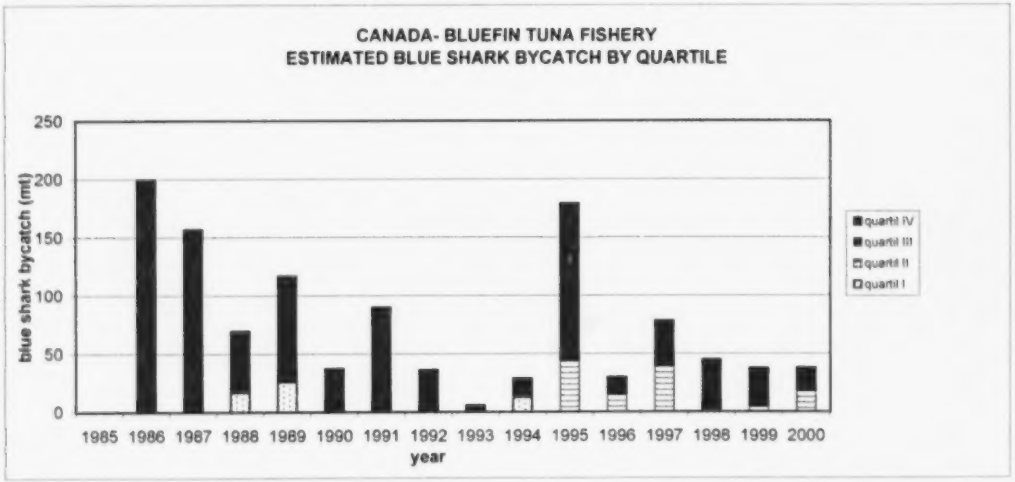


FIG. 7. ESTIMATED BYCATCH IN CANADIAN SWORDFISH FISHERY.

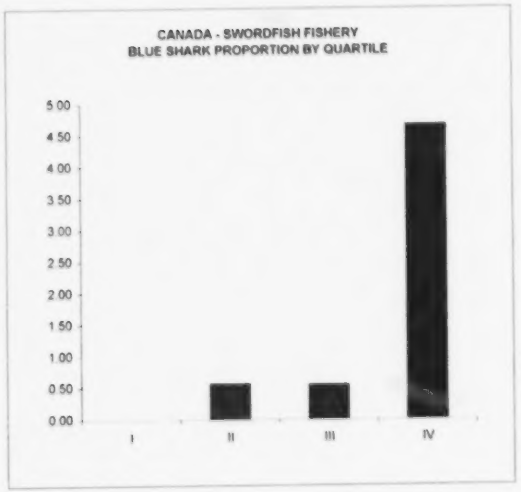
CANADA

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I		
II	0.55	59
III	0.54	835
IV	4.65	77
TOTAL	0.87	971

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986					
1987					
1988		1	284	402	687
1989		2	146	1206	1353
1990			368	874	1242
1991		26	448	790	1264
1992		47	626	1379	2053
1993		39	438	85	563
1994		23	189	0	212
1995		26	1369	2084	3479
1996		4	140	0	144
1997		17	182	0	199
1998		19	1488	287	1794
1999		3	358	8	369
2000		12	811	3	826
MEAN	#DIV/0!	18	527	548	1091



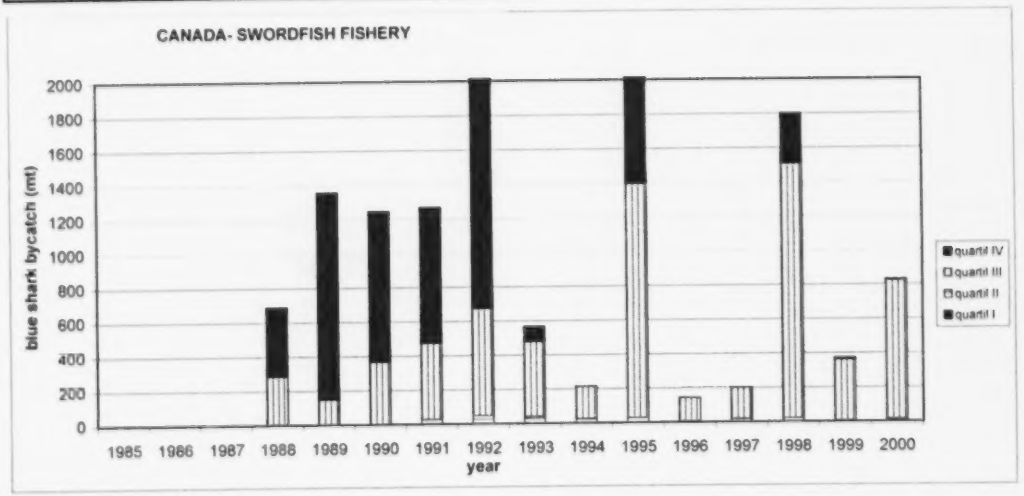


FIG. 8. ESTIMATED BYCATCH IN CANADIAN OTHER TUNA FISHERY.

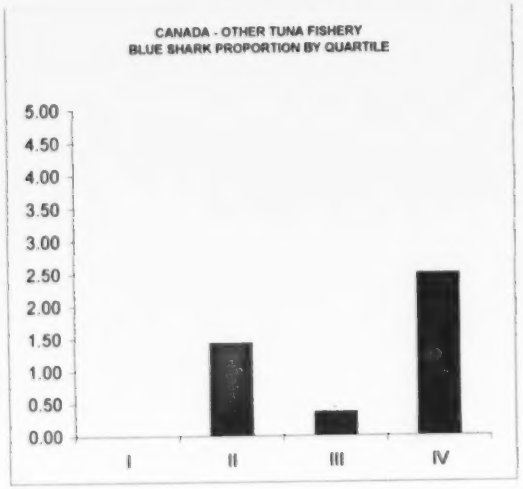
CANADA

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I		
II	1.42	29
III	0.35	110
IV	2.48	108
TOTAL	1.41	247

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986					
1987					
1988			0	412	412
1989			0	20	20
1990			1		1
1991		1	9		10
1992			11		11
1993		17	31		48
1994		34	0	12	46
1995		97	129	16	242
1996		96	5		101
1997		65	0	1	66
1998		60	152	190	402
1999		107	95	112	314
2000		46	160	27	233
MEAN		58	46	99	147



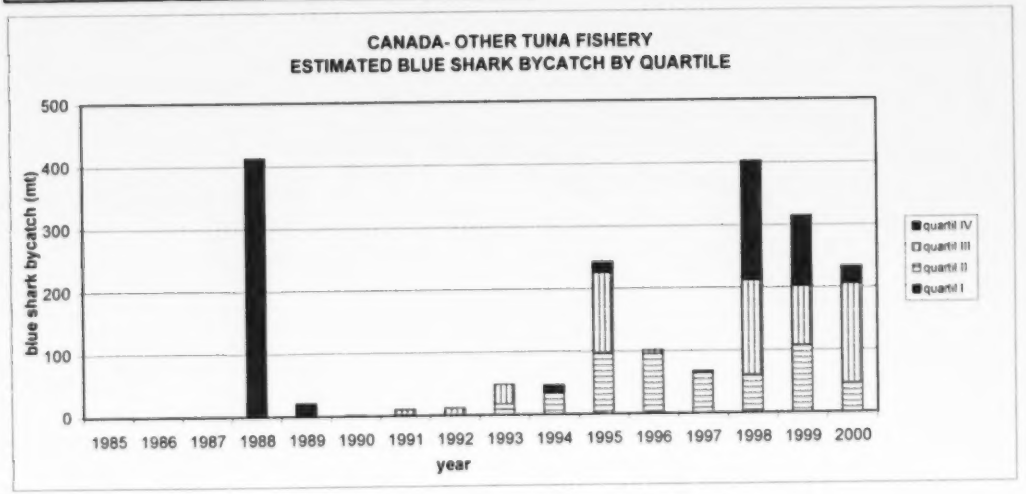


FIG. 9. ESTIMATED BYCATCH IN CANADIAN PORBEAGLE SHARK FISHERY.

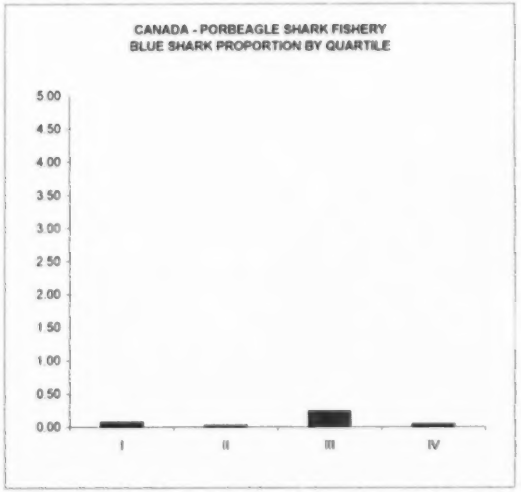
CANADA

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.07	204
II	0.02	251
III	0.24	235
IV	0.04	90
TOTAL	0.10	780

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986					
1987					
1988					
1989					
1990					
1991			6	8	14
1992	5	5	73	8	91
1993		3	21	11	35
1994	5	15	148	18	187
1995	12	5	0	13	30
1996	4	0	4	2	10
1997	2	0	50	8	61
1998	10	11	41	5	67
1999	18	0	3	5	26
2000	12	11	1	5	29
MEAN	8	6	35	8	55



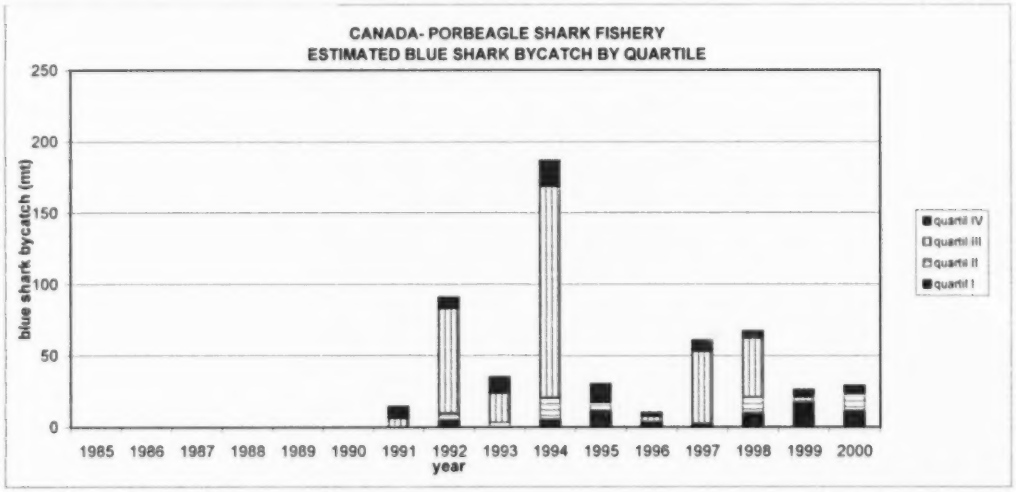


FIG. 10. ESTIMATED BYCATCH IN JAPANESE BLUEFIN TUNA FISHERY.

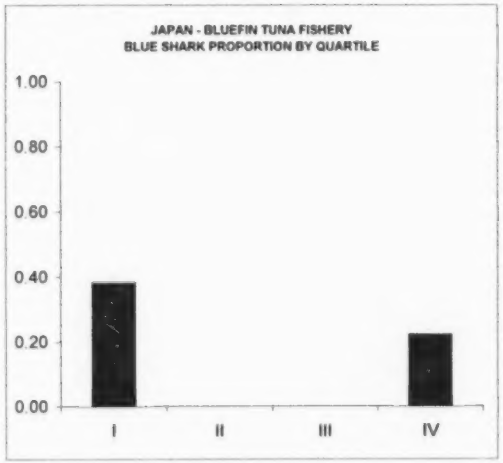
JAPAN

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.38	243
II		
III		
IV	0.22	1355
TOTAL	0.24	1598

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

	BLUE SHARK BYCATCH (mt)				
YEAR	quartile				TOTAL
	I	II	III	IV	
1985					
1986				2	2
1987				9	9
1988	4			8	12
1989	6			14	20
1990				7	7
1991				21	21
1992				28	28
1993	28			20	48
1994	83			7	90
1995				80	80
1996	7			134	142
1997	1			3	4
1998	8			10	19
1999	0			29	30
2000					
MEAN	17	#DIV/0!	#DIV/0!	27	37



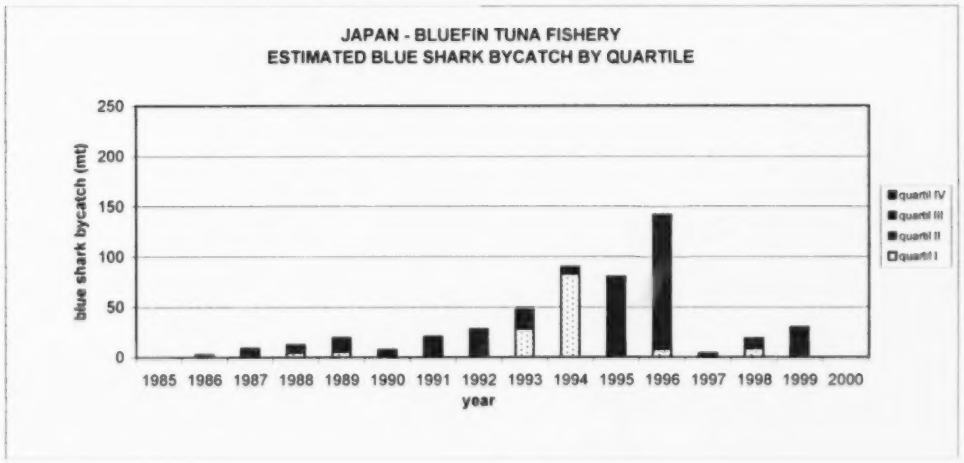


FIG. 11. ESTIMATED BYCATCH IN JAPANESE SWORDFISH FISHERY.

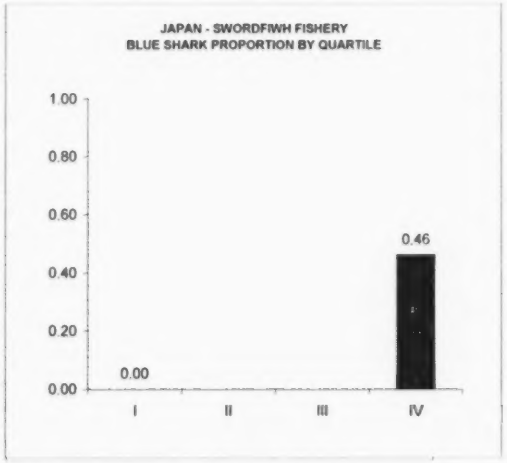
JAPAN

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.00	1
II		
III		
IV	0.46	243
TOTAL	0.46	244

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986				2	2
1987				6	6
1988				1	1
1989	0			17	17
1990				4	4
1991				4	4
1992				2	2
1993				4	4
1994				2	2
1995				1	1
1996					
1997					
1998					
1999					
2000					
MEAN	0	#DIV/0!	#DIV/0!	4	4



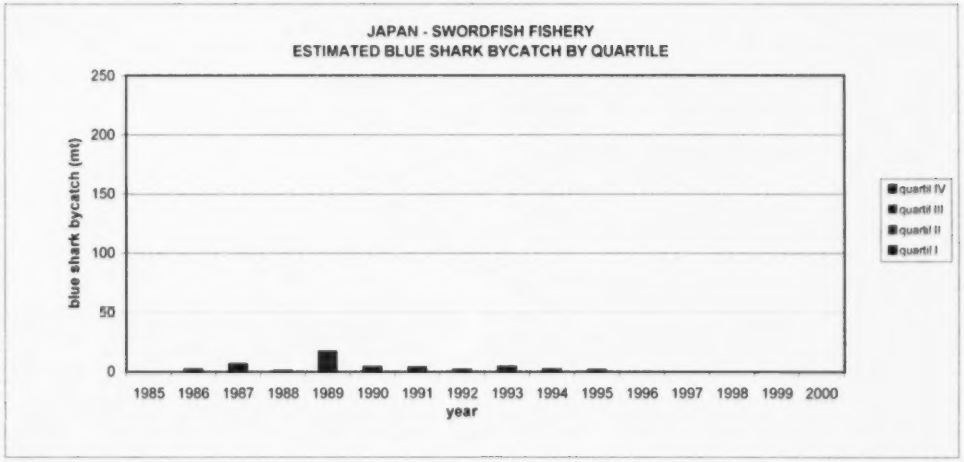


FIG. 12. ESTIMATED BYCATCH IN JAPANESE OTHER TUNA FISHERY.

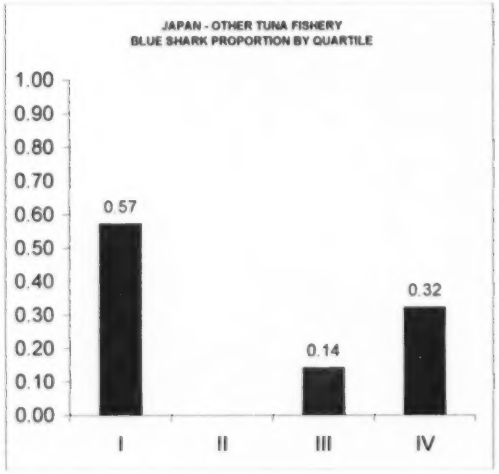
JAPAN

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.57	78
II		
III	0.14	44
IV	0.32	4205
TOTAL	0.32	4327

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile				TOTAL
	I	II	III	IV	
1985					
1986				39	39
1987			7	141	148
1988	3		3	115	121
1989	0			142	142
1990				101	101
1991				109	109
1992				198	198
1993	1			191	192
1994	19			216	235
1995				91	91
1996				88	88
1997	4			23	27
1998	10			14	24
1999				262	262
2000	3				
MEAN	6		5	124	127



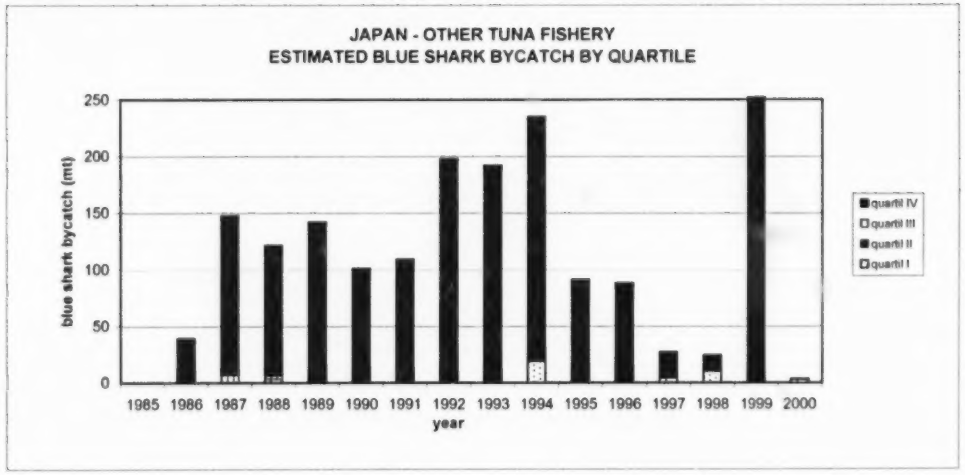


FIG. 13. ESTIMATED BYCATCH IN FAROESE PORBEAGLE SHARK FISHERY.

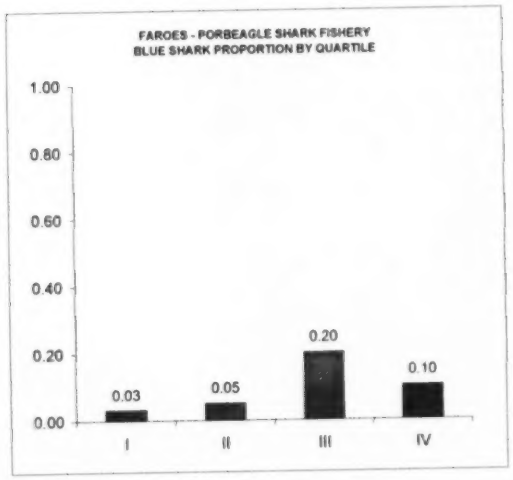
FAROES

BLUE SHARK PROPORTION BY QUARTILE

quartile	prop.	n
I	0.03	55
II	0.05	1475
III	0.20	562
IV	0.10	586
TOTAL	0.09	2678

ESTIMATED BLUE SHARK TOTAL BYCATCH (mt) BY QUARTILE

YEAR	BLUE SHARK BYCATCH (mt) quartile I	II	III	IV	TOTAL
1985					
1986					
1987	0	2	0	1	3
1988	0	2	5	8	16
1989		3	0	5	8
1990	0	4	9	11	24
1991	0	14	30	20	64
1992		52	46	12	110
1993	2	32	23	23	80
1994					
1995					
1996					
1997					
1998					
1999					
2000					
MEAN	0	16	16	11	43



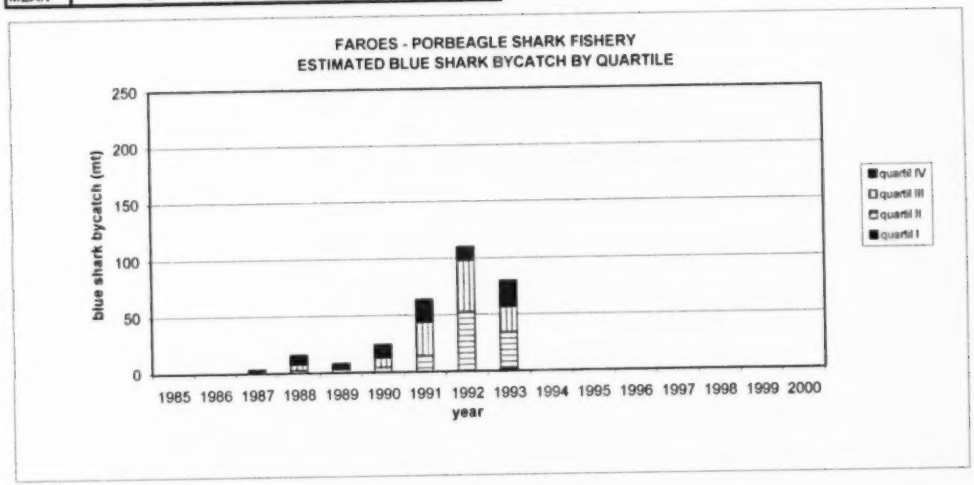


Fig. 14. Frequency histograms of blue shark catch weight per set by country and fishery, as reported by the Maritime Observer Program.

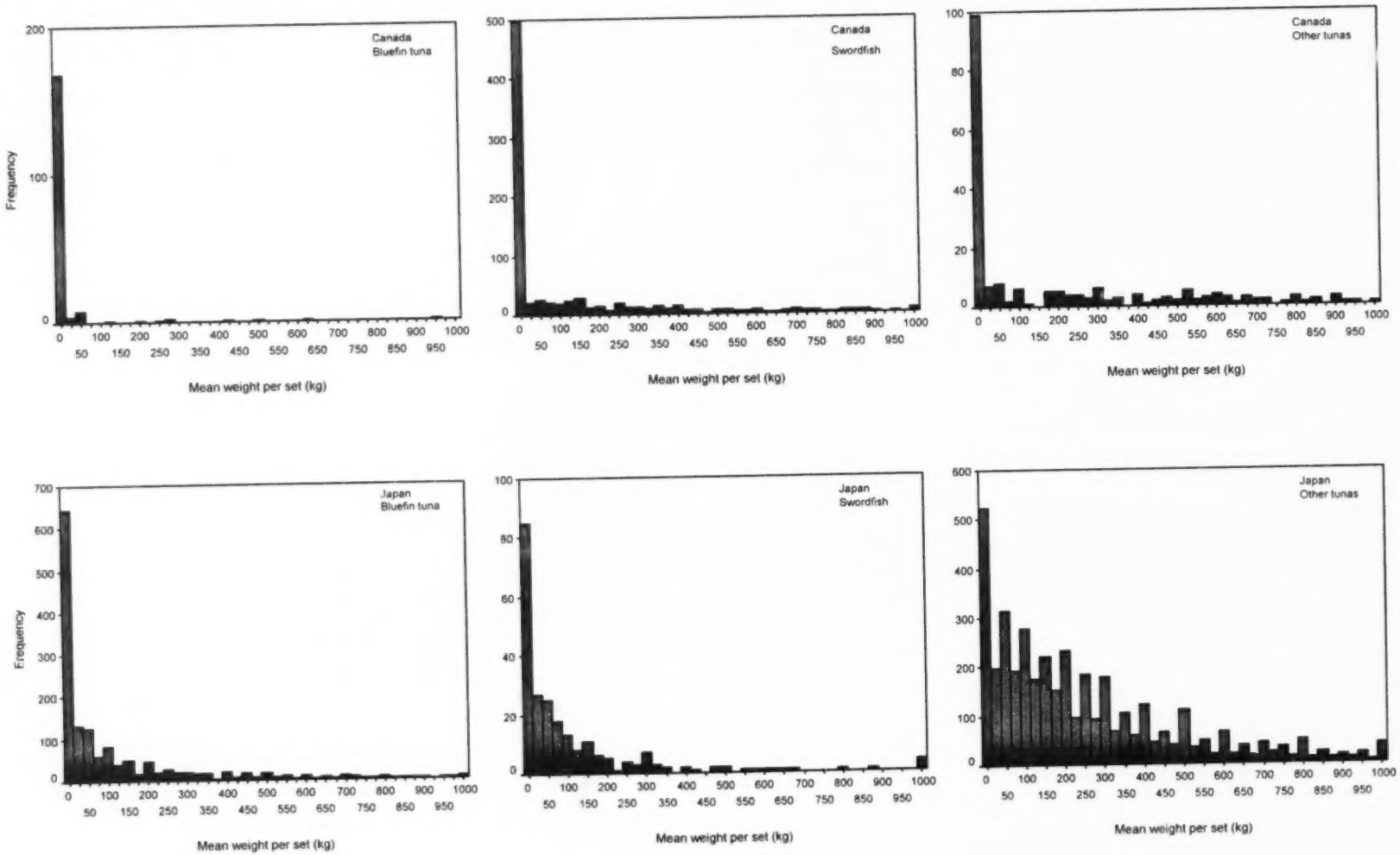


Fig. 14 - cont'd

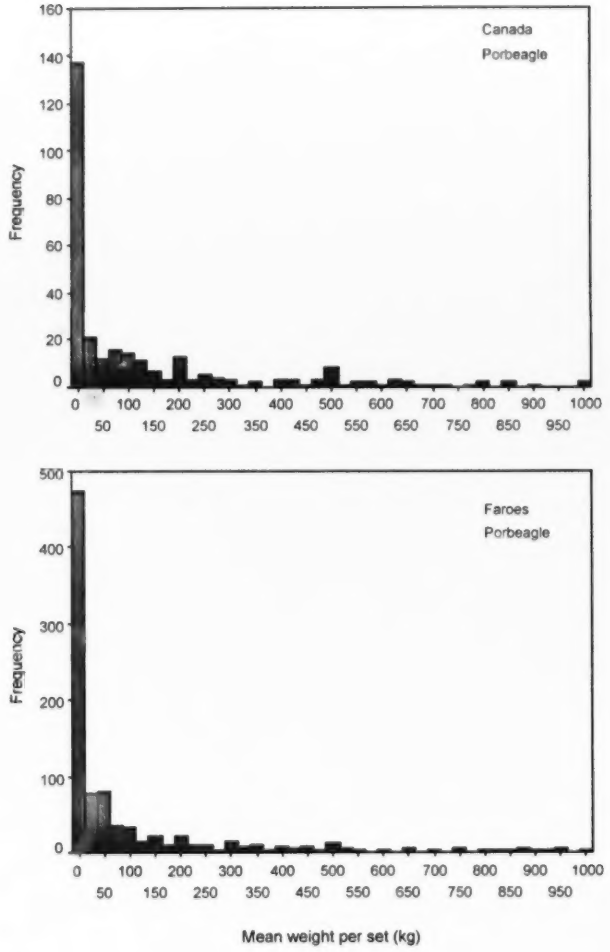

Canada
Porbeagle
Frequency
160
140
120
100
80
60
40
20
0
0 100 200 300 400 500 600 700 800 900 1000
50 150 250 350 450 550 650 750 850 950
Faroes
Porbeagle
Frequency
500
400
300
200
100
0
0 100 200 300 400 500 600 700 800 900 1000
50 150 250 350 450 550 650 750 850 950
Mean weight per set (kg)

Fig. 15. Estimated blue shark catch by country and fishery based on observer records. Minimum catches (solid line) assume all discarded sharks were recorded, while maximum catches (dashed line) assume that zero-shark sets failed to record sharks which were discarded before being brought onto deck.

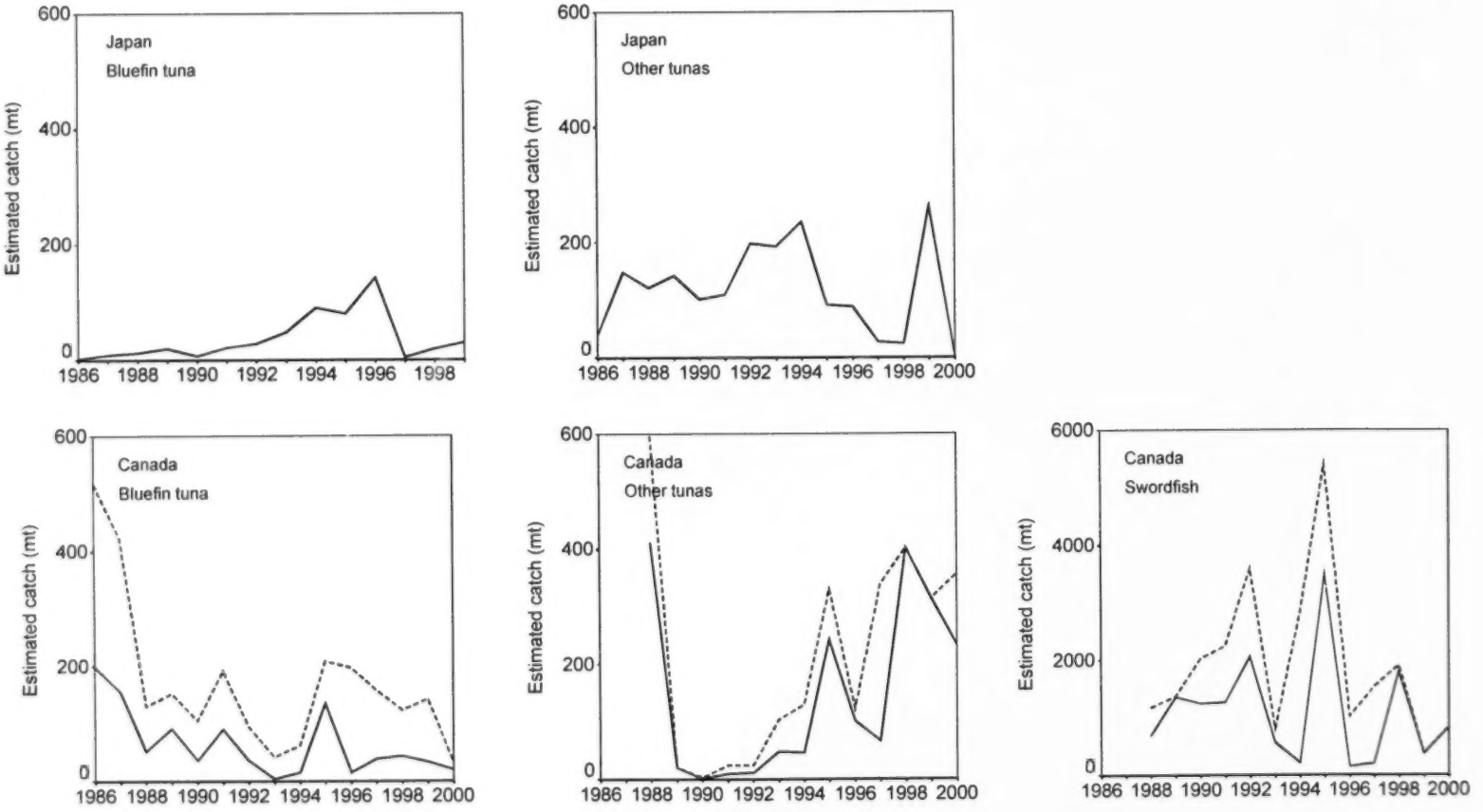


Fig. 16. Total blue shark catch estimates by year by country. Both minimum and maximum estimates are shown.